ZOOGEOGRAPHY OF REPTILES AND AMPHIBIANS IN THE INTERMOUNTAIN REGION

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Abstract.—Few, if any, amphibians and reptiles are endemic to Utah. This is also true for much of the Great Basin, upper Colorado Plateau, southern Idaho, and Wyoming. Many species that would seemingly survive in this inland, mountainous area are not here. Only one widespread salamander and a few frogs and toads have occupied suitable habitats in the area. Lizards and snakes, like the amphibians, provide few distributions that extend throughout the area. A migration which presumably followed the Pleistocene Ice Age brought most of the species into the area as climatic conditions warmed.

Distribution maps of our modern species and subspecies indicate rather clearly that these vertebrates have invaded the Intermountain Region in relatively recent geological time. Only the periphery of Utah and adjoining states to the east and west have been penetrated by many of the species in the regional fauna.

Few, if any, of the amphibians and reptiles now present in Utah are endemic. This is perhaps also true for all intermountain states except those in the south.

There is evidence that for a period of time at the close of the Pleistocene the southern Great Basin deserts were more humid than at present. Studies of fossil pack rat middens (*Neotoma lepida*) by Wells and Jorgensen (1964), indicate that the low desert "ranges in the vicinity of Frenchman Flat (Nevada Test Site) were significantly less arid than at present. Middens now found in areas where the dominant desert shrubs are *Larrea* and *Coleogyne* have the leaves, seed, and twigs of *Juniperus osteosperma* imbedded in the crystalline urine." Wells and Jorgensen (1964) suggest that the present zonal position of the pinyon-juniper forest in southern Nevada is about 600 meters above its position of about 10,000 years ago.

The desert valleys of southern New Mexico, Arizona, and California must have been considerably more moist and humid during at least part of each year at about the same geological time as the valley floors and low foothills of southern Nevada were covered by forests of pinyon and juniper. We assume that climatic conditions then existed which permitted considerable movement of both reptiles and amphibians.

Ballinger and Tinkle (1972) and Larsen and Tanner (1975) have assumed that there were Pleistocene refugia in the southern deserts of the United States and /or Mexico which maintained the ancestral stock from which many of the present species and subspecies of intermountain amphibian and reptilian fauna have arisen. The disjunct populations scattered throughout the "island" mountains of New Mexico and Arizona are highly suggestive of widespread populations being forced from the low valleys into cooler, moister mountains as post-Pleistocene drying slowly but continuously changed the valleys into uninhabitable deserts for many species. The xeric conditions were, however, an invitation for other species to move in, so that the lower Sonoran valleys and their associated mountain refugia now support a rich and varied series of amphibians and reptiles.

If we accept the hypothesis that there was a period of time between the cold, wet Pleistocene and the dry hot conditions of

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today when much of the southwestern United States was warm but still more humid and moist than at present, we can envision a time in which a great migration of amphibians and reptiles moved toward the plateaus and the mountainous areas of the west central United States. Nevertheless, many species of the south did not penetrate to environments in the Intermountain Region which we might expect to be compatible with their needs.

Many North American species that would seemingly survive today in intermountain environments are not here. In June 1942 I had the privilege of escorting Dr. A. H. Wright into various habitats in central Utah. He was indeed disappointed not to find salamanders in the debris and leaf mold in and adjacent to mountain springs. Some species of Plethodontidae have reached northern Idaho and the mountains of central New Mexico. Those in Idaho are related to species along the coast from Washington south into California. We can only surmise that the ancestral stock of these species invaded our area from north central North America after the Ice Age while the northern tier of states was moist enough to permit their movement. It is puzzling why some did not persist in the Snake River Valley and the Uinta and Wasatch mountains of Utah.

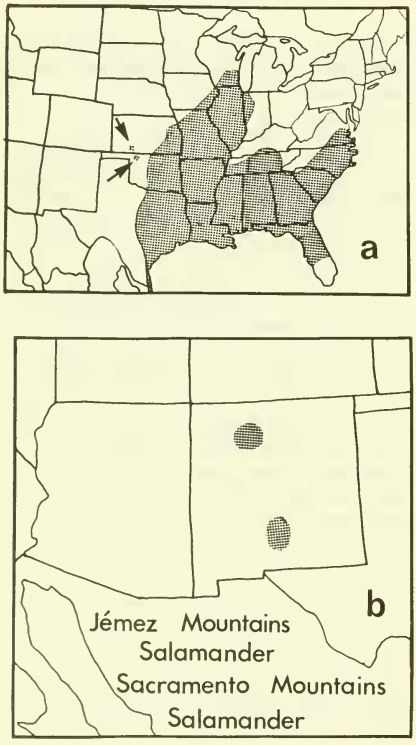

Fig. 1. (a) Known western fossil records of *Ophisaurus attenuatus;* (b) isolated populations of two plethodontid salamanders: upper, *Plethodon neomexicanus,* lower *Aneides hardyi.*

At the close of the Pleistocene, some species expanded their ranges westward across the Great Plains. One example is cited by Etheridge (1961) in which fossil remains of *Ophisaurus attenuatus* were found in glacial deposits some distance west of their present range (Fig. 1a). Unfortunately, few fossils are available to substantiate the movement of other species. The disjunct ranges of many species are highly suggestive however, of the westward movement which was apparently interrupted on the high plains by rapid drying as the ice receded. A few Great Plains species did reach the mountains and are now found as isolated populations (Fig. 1b). Two genera of salamanders reached New Mexico and are found in the Jemez and Sacramento mountains of the southern part of that state: the genera are represented by *Aneides hardyi* and *Plethodon neomexicanus.* One may speculate as to why these or other genera from this large family did not reach Colorado. The best answer available is that the warming at the close of the Ice Age provided moist, warm climatic conditions in what is now the southern Great Plains but less favorable conditions on the central plains. With the ice receding from the mountains, climatic conditions in the southern Great Plains of New Mexico were apparently more moist than at present and similar to the situation

in southern Nevada about 10,000 to 15,000 years ago.

We are aware of only two plethodontid salamanders that have survived. The widespread tiger salamander may have been here during the Pleistocene. If it did exist here during the Pleistocene, it may represent one of the few species able to survive that period by remaining in the region. Once the valleys became dry, the salamanders were isolated in the mountaintops with no opportunity to expand their range. Presumably, their isolated mountain distribution and the rapidly drying conditions prevented them from reaching Colorado. To the west, north, and south of Utah the deserts developed rapidly. Glacial lakes which were present in many Great Basin valleys disappeared or were reduced to salty remnants; associated vegetation changes isolated amphibians in small areas around waterways and desert springs (Figs. 2c, 2d, and 9).

The drying out and warming of the southern portions of this vast inland area

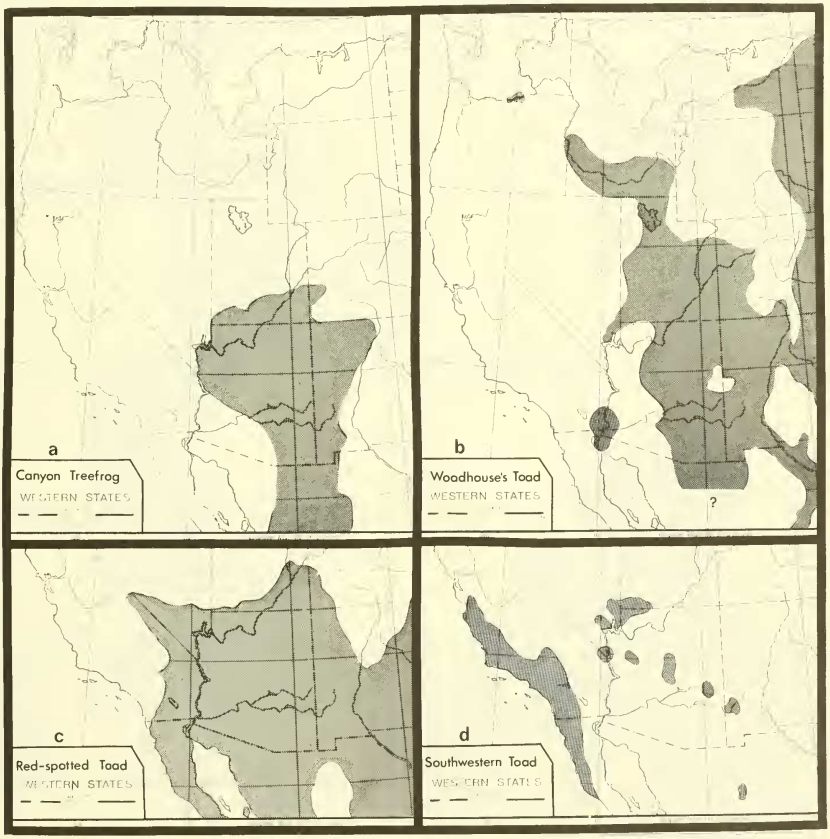

Fig. 2. Distribution of some amphibians in the southwestern United States: (a) Canyon treefrog, *Hyla arenicolor;* (b) Woodhouse's toad, *Bufo woodhousei;* (c) red-spotted toad, *Bufo punctatus;* and (d) southwestern toad, *Bufo microscaphus.*

provided an opportunity for species in the southern deserts (northern Mexico and perhaps some areas in Sonora, Chihuahua, and Coahuila) to expand their ranges northward. It is now possible to detect some such range expansions along valleys running north and west from the international border.

Time does not permit an examination of all species, but we can examine one. The leopard lizard, *Crotaphytus wislizeni*, appears to have emerged from a refugium in the Chihuahua-Coahuila area and followed routes approximately as indicated by the arrows in Figure 3a. The migration resulted

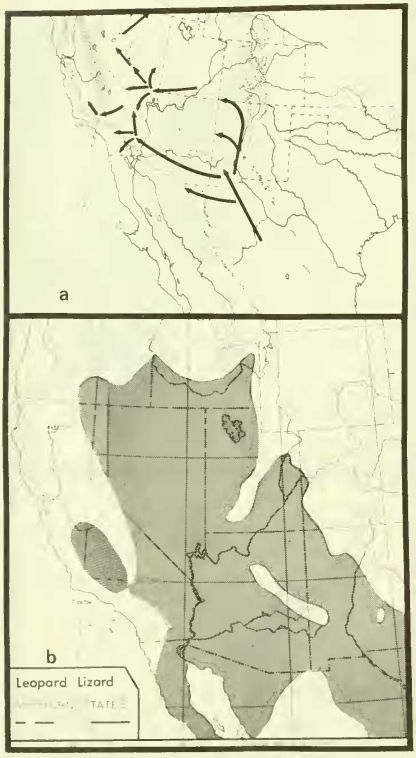

Fig. 3. (a) The theorized flow distribution for the leopard lizard *Crotaphytus wislizeni;* (b) geographical distribution as known today.

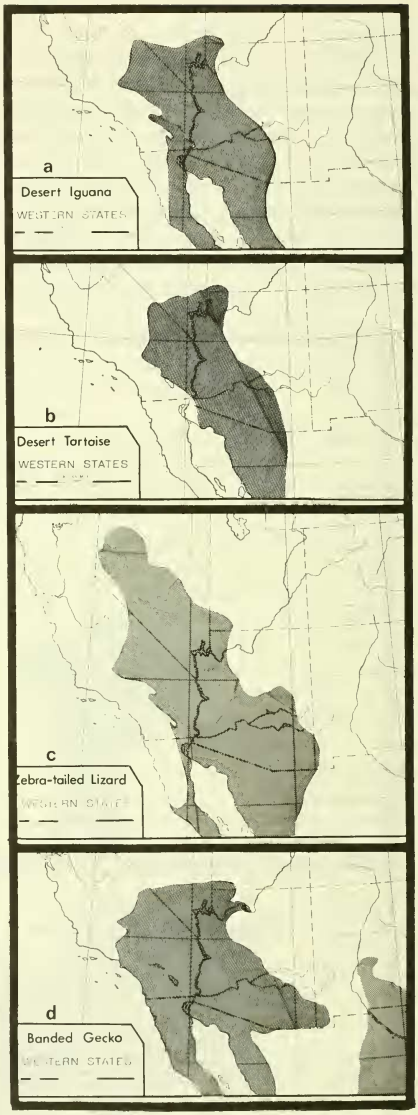

Fig. 4. Present-day distribution of southwestern reptiles: (a) desert iguana, *Dipsosaurus dorsalis;* (b) desert tortoise, *Gopherus agassizi*, (c) zebratailed lizard, *Callisaurus draconoides;* and (d) banded gecko, *Coleonyx variegatus.*

in the distributional pattern for the species shown in Figure 3b. In this and other species occupation of some areas produced semi-isolation, and geographical subspecies have evolved in such areas as the Colorado Plateau, Virgin River Valley, and the Great Basin of Utah and Nevada. This is true not only for the leopard lizards but for most of the species that have extended their ranges into the northern and western valleys.

Not all species moved as far or perhaps as fast. An examination of present-day ranges are the best indicators of the general movements that occurred. The following list of 23 species (Figs. 2 and 4-8) all show range extensions into the Great Basin and the valleys of the Colorado drainage. Some species have either expanded their range more rapidly or have been able to cross elevation barriers of 5,000 feet or higher (Figs. 5 and 6) while others have not (Figs. 4 and 8).

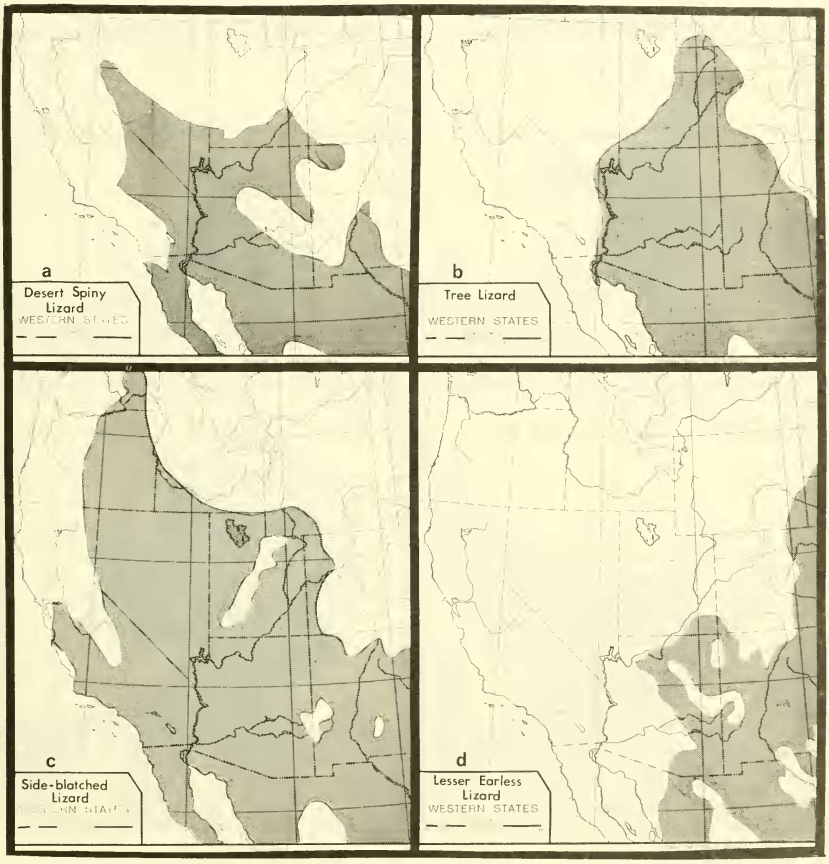

Fig. 5. Distribution of southwest reptiles: (a) Desert spiny lizard, *Sceloporus magister;* (b) tree lizard, *Urosaurus ornata;* (c) side-blotched lizard, *Uta stansburiana;* and (d) less earless lizard, *Holbrookia maculata.*

1. Southwestern toad (*Bufo microscaphus*)
2. Woodhouse toad (*Bufo woodhousei*)
3. Red-spotted toad (*Bufo punctatus*)
4. Canyon treefrog (*Hyla arenicolor*)
5. Desert tortoise (*Gopherus agassizi*)
6. Banded gecko (*Coleonyx variegatus*)
7. Desert iguana (*Dipsosaurus dorsalis*)
8. Zebra-tailed lizard (*Callisaurus draconoides*)
9. Lesser Earless lizard (*Holbrookia maculata*)
10. Desert spiny lizard (*Sceloporus magister*)
11. Side-blotched lizard (*Uta stansburiana*)
12. Tree lizard (*Urosaurus ornata*)
13. Western Whiptail (*Cnemidophorus tigris*)
14. Western Blind Snake (*Leptotyphlops humilis*)
15. Western Patch-nosed Snake (*Salvadora hexdepis*)
16. Coachwhip Snake (*Masticophis flagellum*)
17. Glossy Snake (*Arizona elegans*)
18. Common Kingsnake (*Lampropeltis getulus*)
19. Black-necked Garter Snake (*Thamnophis cyrtopsis*)
20. Western Ground Snake (*Sonora semianulata*)
21. Mojave Rattlesnake (*Crotalus scutulatus*)
22. Speckled Rattlesnake (*Crotalus mitchelli*)
23. Sidewinder (*Crotalus cerastes*)

Some species must have survived the Pleistocene in refugia that lay between the

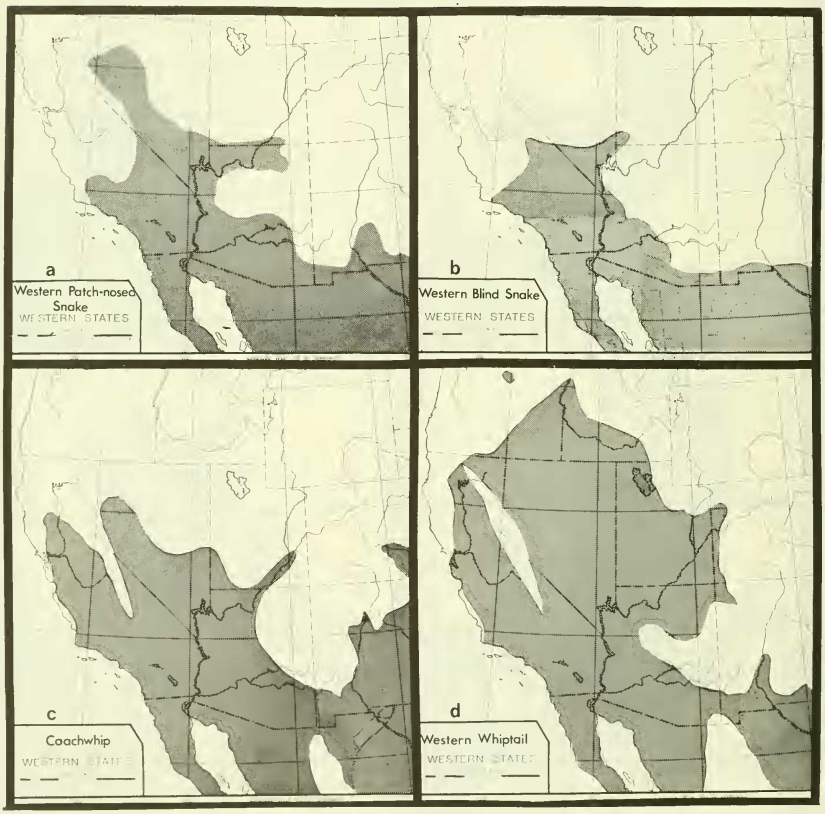

Fig. 6. Distribution of southwestern reptiles: (a) Western patchnosed snake, *Salvadora hexalepis;* (b) western blind snake, *Leptotyphlops humilis;* (c) coachwhip, *Masticophis flagellum;* and (d) western whiptail, *Cnemidophorus tigris.*

cold climates of the mountains and the drier, mild climates of southern plains. Such species include:

1. The Western Toad (*Bufo boreas*)
2. Spotted Frog (*Rana pretiosa*)
3. Rubber Boa (*Charina bottae*)
4. Western Garter Snake (*Thamnophis elegans*)

Such species seemingly have moved north as climatic conditions permitted. They occupied only mountain valleys in the southern parts of their present range (Fig. 9).

Other species have apparently moved into the Intermountain Region from the northern or central Great Plains. Such species include:

1. The Chorus Frog (*Pseudacris triseriata*)
2. Smooth Green Snake (*Opheodrys vernalis*)
3. Racer (*Coluber constrictor*)

These are eastern species which seem to have entered through the northern Great Plains (Fig. 10). Presumably, the smooth green snake had a much wider distribution in earlier times than at present. This is indicated by its disjunct distribution.

If there are reptile species that survived the Pleistocene in the lower valleys of the Great Basin of Utah and Nevada, the short-

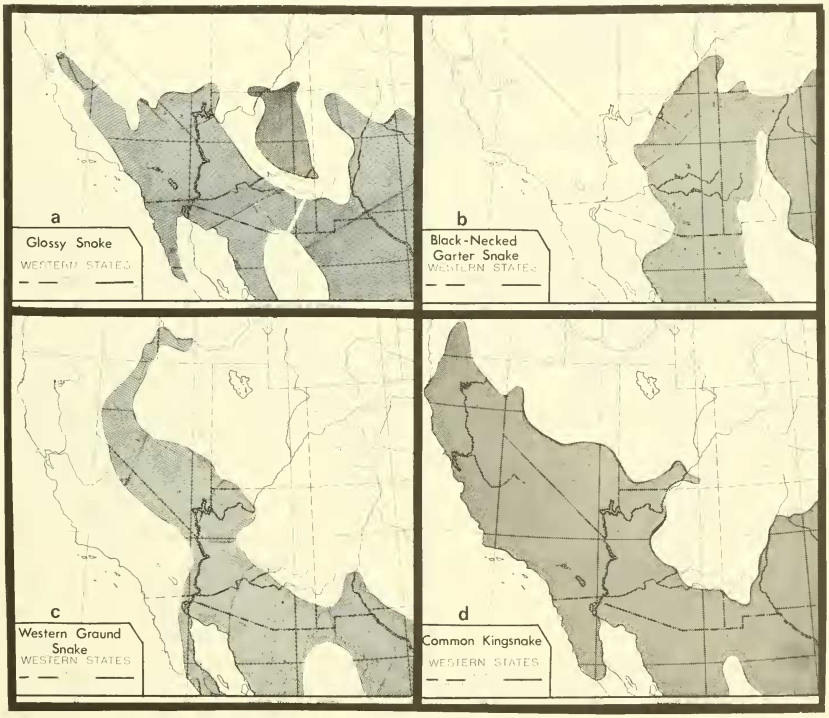

Fig. 7. Distribution of southwestern reptiles: (a) Glossy snake *Arizona elegans;* (b) black-necked garter snake, *Thamnophis cyrtopsis;* (c) western ground snake, *Sonora semianulata;* and (d) common kingsnake, *Lampropeltis getulus.*

horned lizard (*Phrynosoma douglassi*), the western skink (*Eumeces skiltonianus*), Fig. 10a), and the sagebrush lizard (*Sceloporus graciosus*) are the species most likely to have done so. These species now range from the valleys up to at least 9,000 feet in the mountains and plateaus.

In summary, we can conclude that the ancestral stocks of the great majority of present day intermountain amphibians and reptiles originated either to the south or east of the area in question. By far the greater numbers of both amphibians and reptiles came from the south or the southeast.

The Intermountain West is a good, if not a classical, example of the David Starr Jordan theory. He stated that animals have three alternatives if radical changes occur in the environment:

1. They can follow the environment and thus remain constant.
2. They can remain and adapt to the new environment.
3. If they can do neither, they will become extinct.

It may not be possible to cite an example of a reptile or amphibian that has remained constant. Yet we do have some that have wide distributions and little morphological divergence. Two examples are the *Charina bottae* and the *Bufo boreas*. Both have wide distribution with little external variation.

Without a fossil record, we do not know how many amphibians and reptiles existed in our area since late Pleistocene time and were unsuccessful in the struggle for survival. Presumably, we have had during the last ten thousand to fifteen thousand years substantial environmental changes that offered challenges beyond the ability of some species to adapt. Other species have extended their range through adaptive radiation, which increased the number of geographical subspecies or morphological clines in the species as isolated habitats were occupied.

There is reason to believe that the movement north is still occurring. The establishment of populations of *Crotalus mitchelli* and *C. scutulatus* in Utah appear to be recent (Fig. 8). The first specimen of *C. scutulatus* was taken in 1954 and the first *C. mitchelli* in 1960. Both were taken on the southwest slope of the Beaver Dam Mountains, only a few miles inside Utah. Since then, these species have apparently expanded their ranges and are seen more often by field workers.

The northern plateau Lizard (*Sceloporus*

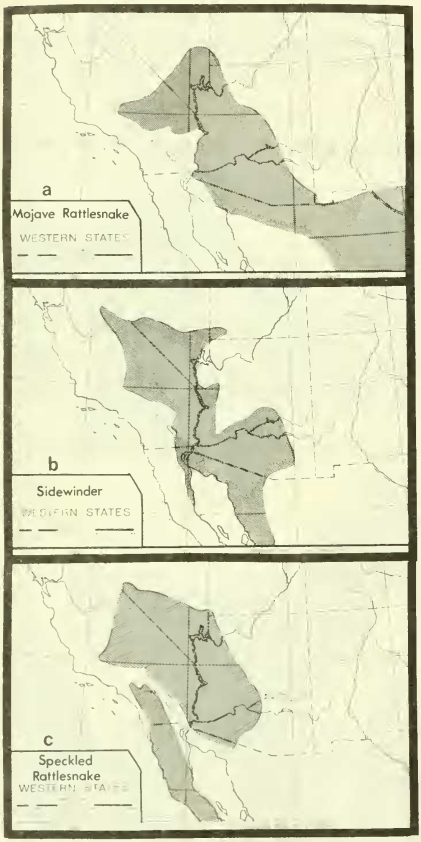

Fig. 8. Distribution of southwestern reptiles: (a) Mojave rattlesnake, *Crotalus scutulatus;* (b) sidewinder, *Crotalus cerastes;* and (c) speckled rattlesnake, *Crotalus mitchelli.*

u. elongatus) has in recent times crossed the central plateaus of Utah through the low areas between Emery and Salina and now occurs along the foothills extending north to Ephraim and south to Monroe. We do not have records of this species west of the Se-

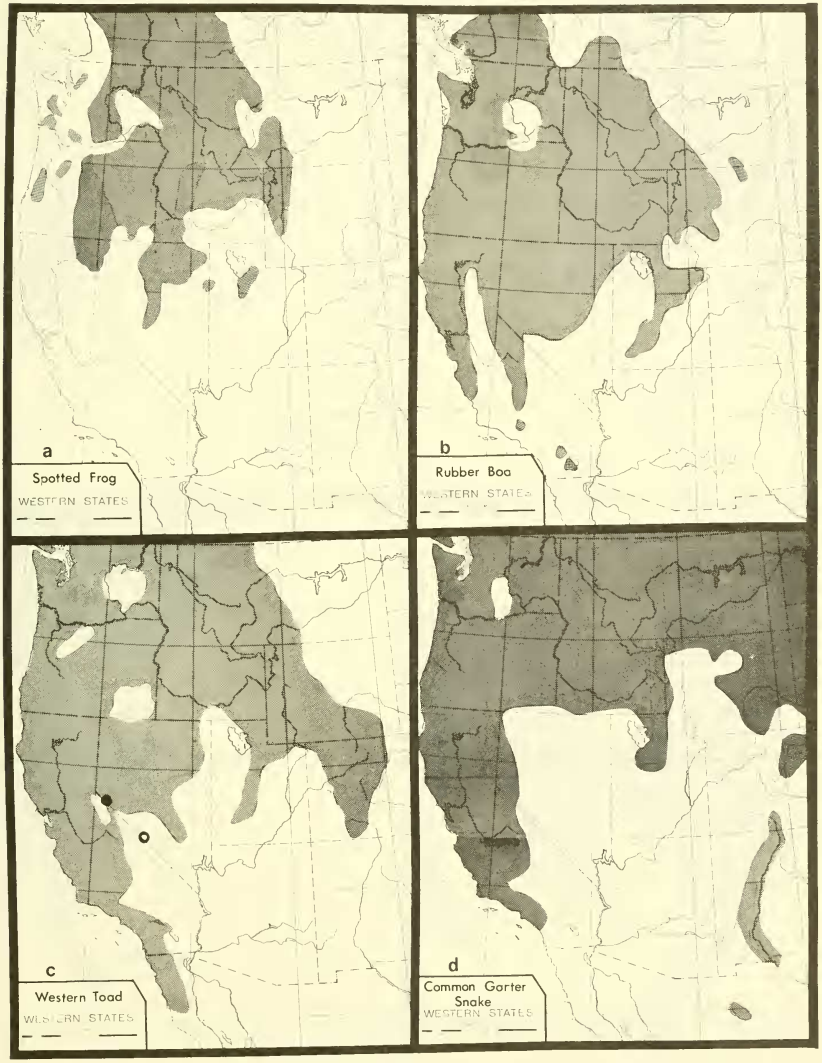

Fig. 9. Amphibians and reptiles with a more northern distribution but with populations extending south into parts of the Intermountain West and the Great Basin: (a) Spotted frog, *Rana pretiosa;* (b) rubber boa, *Charina bottae;* (c) western toad, *Bufo boreas;* and (d) common garter snake, *Thamnophis sirtalis.*


a
Western Skink
b
Smooth Green Snake
c
Racer
d
Chorus Frog

vier River. A specimen of the long-nosed snake (*Rhniocheilus lecontei*) was recently taken south of Dragerton—an indication that this species is still expanding its range.

In conclusion, it should be noted that many areas in Utah (some local, others extensive) have had their reptile populations reduced by human activity. The most common disruptive influence has been overgrazing on some private, Bureau of Land Management, and state lands.

Figures 1b, 3b, and 4-10 are taken largely from Stebbins (1966). Figure 1a is from Etheridge (1961). Even though the distribution maps have not been brought up to date for 10 years, the ranges of species used in this study have changed little.

Literature Cited

Ballinger, R. E., and D. W. Tinkle. 1972. Systematics and evolution of the genus *Uta* (Sauria: Iguanidae). Misc. Publ. Mus. Zool. Univ. Michigan 145: 1–83.

Etheridge, R. 1961. Late Cenozoic glass lizards (*Ophisaurus*) from the southern Great Plains. Herpetologica 17: 179–186.

Larsen, K. R., and W. W. Tanner, 1975. Evolution of the scleroporine lizards (Iguanidae). Great Basin Nat. 35: 1–20.

Stebbins, R. C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston.

Wells P. V., and C. D. Jorgensen. 1964. Pleistocene wood rat middens and climatic changes in the Mojave Desert: a record of juniper woodlands. Science 143: 1171–1173.

Fig. 10. Amphibians and reptiles which have a more northern distribution but which seemingly have entered the intermountain and Great Basin areas from the central Great Plains: (a) Western skink, *Eumeces skiltonianus* (this distribution is more comparable to those in Fig. 9); (b) smooth green snake, *Opheodrys vernalis*; (c) racer, *Coluber constrictor*; and (d) chorus frog, *Pseudacris nigrita*.